

Attachment 6.2

**Report on the Draft 2003 Air Quality Management Plan: Aviation Chapter**

AVIATION TECHNICAL ADVISORY COMMITTEE

April 10, 2003

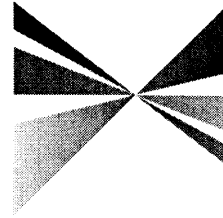
**Memorandum**

**Date:** March 25, 2003

**To:** ATAC

**From:** Molly Hoffman, SCAG Senior Air Quality Planner  
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SOUTHERN CALIFORNIA



**ASSOCIATION of  
GOVERNMENTS**

**RE: 2003 Draft South Coast Air Quality Management Plan: Aviation Chapter**

**RESCHEDULED FROM THE MARCH 2003 ATAC MEETING**

The South Coast Air Quality Management District (SCAQMD) has recently released its Draft 2003 South Coast Air Quality Management Plan (SCAQMP) which is the blueprint for achieving clean air standards in Southern California by the end of the decade. The SCAQMP outlines a control strategy to meet the federal health standards for ozone by 2010 and for fine particulates, known as PM10, by 2006. The overall strategy is comprised of the SCAQMD's stationary and mobile source control measures; the California Air Resources Board's (CARB's) State and Federal Element; SCAG's Transportation Control Measures; and a supplemental strategy. The State and Federal Element outlines proposed emission reduction strategies for consumer products and mobile sources, which includes aircraft and airports, as described in Chapter G of CARB's Plan (see attachment).

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## **CHAPTER G.      AIRCRAFT AND AIRPORTS**

This chapter discusses aircraft as well as other sources that are located at or access the airport—ground service equipment (GSE) and ground access vehicles. Turboprops, smaller business jet aircraft, and piston engine aircraft, which include all propeller driven aircraft, make up only a small percentage of aircraft emissions and are not addressed in this chapter.

The primary pollutants emitted by jet aircraft engines are ROG, NO<sub>x</sub>, CO, PM<sub>10</sub>, and CO<sub>2</sub>. Jet aircraft also emit a host of toxic compounds, including 1,3-butadiene and formaldehyde.

### **1.      Category Description**

The emission sources of concern at the airport are divided into three categories: jet aircraft, ground service equipment, and ground access vehicles.

#### **a.      Jet Aircraft**

Jet aircraft are a growing source of emissions at California's commercial airports due to the large increase in air travel. Jet aircraft are long-lived, with the average economic life of a passenger aircraft on the order of 28 years and up to 40 years for all-cargo aircraft. (Cargo aircraft last longer because they undergo fewer landing and takeoff cycles and accumulate less annual operational hours than passenger jets.) The long lives of these emission sources underscore the need for more stringent emission standards for jet aircraft.

Like any motorized vehicle, aircraft produce emissions as long as the engine is running or idling. However, the aircraft operations of most concern for a nonattainment area are those that occur during takeoff, landing, approach, climb-out, and taxiing.

Fuel is a major operating expense for airlines; therefore, airlines have and continue to put a high priority on fuel-efficient engines. Since 1975, on a per passenger mile basis, the airline industry has experienced 75 and 20 percent reductions in ROG and CO<sub>2</sub> emissions, respectively, due to increased fuel efficiency. However, NO<sub>x</sub> emissions from new engines introduced into service have been declining by only about one percent per year. This is due to the tradeoff that results when temperature and pressure in the engine's combustion chamber are increased to enhance fuel efficiency at the expense of NO<sub>x</sub> emissions.

The National Aeronautics and Space Administration (NASA) conducts most of the original research and development work on new turbine engine technology and has

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a multi-year program to develop lower emitting jet engines. One target is to introduce an engine that can emit 70 percent less NO<sub>x</sub> than the current International Civil Aviation Organization (ICAO) standard. Aircraft engine manufacturers have also been working to develop engines with lower NO<sub>x</sub> emissions while improving fuel efficiency. At issue is whether lower NO<sub>x</sub> engines will be available and introduced into the fleet in sufficient quantities to offset the emissions associated with the projected increase in air travel.

New noise standards that have been approved by ICAO but not yet promulgated by the Federal Aviation Administration (FAA) could also increase NO<sub>x</sub> emissions; however, advanced engine combustor technologies could reduce noise and future NO<sub>x</sub> emissions.

As with automobiles and trucks, most aircraft can be ordered with different models of aircraft engines, each potentially having different emission levels. When ordering an aircraft, an air carrier's first consideration is to ensure the engine matches the operational requirements intended for the aircraft. In addition, previous contractual agreements or desire for fleet consistency can influence selection of a particular engine model. A national aircraft emissions reduction stakeholders group has discussed various potential aircraft emission reduction measures; one would be to have air carriers commit to order new aircraft with engines having the lowest emissions certified for that aircraft consistent with its intended mission. Further evaluation could help determine the full extent of opportunities for achieving lower NO<sub>x</sub> emissions through such purchases and identify potential pollutant tradeoffs that could occur.

Some airports have also been exploring means for reducing aircraft emissions. Airports in Zurich, Switzerland and Boston, Massachusetts are pursuing revenue-neutral emission based landing fees that provide lower emission fees for lower emitting aircraft and, conversely, higher fees for higher emitting aircraft. Such fee systems are intended to provide air carriers an incentive to purchase and operate aircraft with lower emission engines.

As noted above, the aircraft emissions of most concern to State Implementation Plans are those that occur when aircraft are operating at an airport or during takeoff and approach. Thus, ground-based operational practices provide potential opportunities for emission reductions. These include having aircraft reduce multi-engine taxiing on the runway, having aircraft use the electricity at the gates instead of the auxiliary power unit on the aircraft to provide power while parked at the terminal, and having the airport provide efficient taxiway configurations to reduce aircraft congestion. There are a number of operational measures in the "tool box," but many are totally dependent on aircraft pilot judgment as to what is safe and feasible in each particular situation. Nevertheless, these strategies have resulted in meaningful and cost-effective emission reductions in the past and potentially could provide more.

Aircraft engine exhaust also contains PM; however there are limited data on the specific components of the PM in the exhaust at this time. Although jet fuel is chemically similar to diesel fuel, ARB has not been able to determine whether aircraft exhaust PM has similar toxicity as diesel exhaust PM. The highest PM emission rates occur during high power operations of takeoff and climb-out when there is high fuel consumption. Because these operations occur at or near airports, communities located adjacent to airports have raised concerns about the potential risk from exposure to toxic compounds.

**b. Ground Service Equipment**

Ground service equipment (GSE) are specialized off-road equipment that perform a variety of functions in support of aircraft operations, including aircraft towing, maintenance, fueling, baggage handling, cargo loading, and food service. They are largely uncontrolled with typically long vehicle and equipment life. To reduce costs, airlines frequently rebuild GSE engines, thereby extending the life of the older, higher polluting units, rather than purchase new, lower polluting equipment. Engine deterioration, along with aging equipment and parts, increases ROG, NOx, and PM emissions. Another contributor to high GSE ROG and diesel PM emissions is extended engine idling. GSE use is primarily a function of the number of aircraft takeoffs and landing. To the extent that airline traffic and total annual passengers increase, GSE equipment and usage will also increase – as will emissions.

**c. Ground Access Vehicles**

Ground access vehicles move airport passengers, employees, and goods to, from, and around the airport. These vehicles include private passenger vehicles, airport shuttles, taxis, hotel shuttles, parking shuttles, cargo vehicles, and tenant and employee vehicles.

Ground access emissions at airports are not accounted for separately in the ARB emission inventory. Rather, these emissions are included within other motor vehicle emission source categories. Ground access emissions vary by airport and surrounding land uses. However, traffic-related NOx emissions can be as high as 50 percent of total airport-related NOx emissions and ROG as much as 80 percent of the total.

Strategies to reduce emissions from ground access vehicles take several different forms because of the variety and ownership of the vehicles involved. Following are examples of strategies to reduce ground access vehicle emissions that are (or could be) implemented by California airport operators.

Reduce Emissions from Airport Vehicles: Some airport operators are reducing emissions from their own vehicle fleets, through the acquisition of either ZEVs or

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alternate fuel vehicles. A number of airports are already moving in this direction with CNG and LNG shuttle buses. Another option is purchase of ULEV or SULEV models where available when replacing fleet vehicles. The airport could also reduce diesel PM emissions by retrofitting diesel vehicles with PM filters or to purchase new diesel vehicles equipped with a PM filter.

Provide Alternative Fuel/Electric Infrastructure: By providing fueling and charging infrastructure, airports can facilitate use of ZEVs and alternative-fuel vehicles. Some examples include alternate fuel dispensers for airport owned vehicles, availability of alternate fueling facilities for non-airport vehicle operators at consolidated facilities or at downtown airport shuttle terminals, or people movers to reduce vehicle trips. The magnitude of associated emission reductions would be dependent on the exact nature of the infrastructure.

Transportation Options: Consolidating and streamlining on-airport vehicle travel can reduce emissions and decrease public exposure to toxics at terminals. For vehicles not owned by the airport, there is a mix of fee adjustment, incentive, and public education programs. Because airports vary in the way they operate and their specific operating authority, programs would need to be tailored to each airport's specific situation.

Cleanest Vehicles: Airports could require shuttle and taxi fleet operators to operate fleets with progressively higher percentages of new vehicles or those meeting optional low emission standards, such as ULEV or SULEV vehicles. Another program would have airports that have the authority charge variable access fees consistent with the emissions level of the vehicle. The overall objective would be to require or provide incentives to fleet operators to reduce emissions at a faster rate than would occur with "normal" fleet turnover or company purchase policies.

Viable Alternative Ground Transportation Choices: In order to reduce off-airport vehicle emissions, airports could provide travelers more viable ground transportation options, and also provide commute programs for airport employees.

The airports could promote airport and airport tenant employee commute programs, including lower parking rates and priority parking for carpoolers, an airport-sponsored integrated employee clean fuel shuttle system, an employees' carpool and vanpool matching system, and subsidized or free employee transit and shuttle fares.

Offsite park and ride or "fly away" lots also can reduce vehicle trips to the airport and relieve airport congestion and localized CO emissions. The Van Nuys FlyAway terminal checks people in and then express buses them to the main terminal at Los Angeles Airport. The magnitude of the emission reductions from these facilities would depend on their location, number of trips offset, and the emission characteristics

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of airport shuttles. The success of such measures would also be highly dependent on a close collaboration with local and regional transportation planning agencies and transit authorities. Long range transit service plans for the region would need to consider providing adequate service to the airport.

Public Education: Finally, public education is a critical component to any airport transportation program. The public needs to be fully aware of the various modes of travel available to the airport and the economic and environmental benefits of one mode versus another.

## **2. Emission Trends<sup>1</sup>**

The baseline and projected emissions from aircraft and ground support equipment are shown in Table II-G-1. Between 1980 and 1999, commercial air passengers increased by about 125 percent nationally and more than doubled in California. Air cargo tonnage is growing more rapidly than air passengers, at nearly six percent per year, a rate that is expected to continue through 2012.

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<sup>1</sup> The emissions estimates provided do not reflect the impact of events on September 11, 2001. Air travel dropped dramatically in the short term and nearly all air carriers experienced severe financial setbacks. Air carriers have responded by reducing the number of flights, retiring older, less efficient aircraft, and generally scaling back operations in an effort to cut expenses. Air travel in the long term is expected to increase, although whether air travel returns to pre-September 11 growth rates or lower-than-earlier-projected rates remains to be seen.

**Table II-G-1**  
**Baseline Emissions for Aircraft/Airports**  
**(South Coast, Summer Planning, tpd\*)**

| <b>Pollutant<br/>Source<br/>Category</b> | <b>2000</b> | <b>2010</b> | <b>2020</b> |
|--|-------------|-------------|-------------|
| <b>ROG</b>                               |             |             |             |
| Aircraft                                 | 6.1         | 5.4         | 7.1         |
| -  |             |             |             |
| Commercial                               | 1.9         | 2.8         | 4.4         |
| -Military                                | 3.5         | 1.9         | 1.9         |
| -General                                 | 0.7         | 0.7         | 0.8         |
| Aviation                                 |             |             |             |
| Ground<br>Service<br>Equipment           | 1.0         | 0.5         | NA          |
| <b>NOx</b>                               |             |             |             |
| Aircraft                                 | 23.1        | 32.1        | 40.1        |
| -  |             |             |             |
| Commercial                               | 21.7        | 29.2        | 37.3        |
| -Military                                | 1.3         | 2.8         | 2.8         |
| -General                                 | 0.1         | 0.1         | 0.1         |
| Aviation                                 |             |             |             |
| Ground<br>Service<br>Equipment           | 6.9         | 3.2         | NA          |

During the past 25 years, national commercial aircraft emissions increased 25 percent for ROG and 66 percent for NOx. In California, aircraft emissions of ROG plus NOx in 2000 were about two percent of all mobile source ROG plus NOx emissions. However, by 2020, this percentage is expected to more than double. Newer (and cleaner) aircraft engines continue to be introduced into the fleet. Nevertheless, without additional measures, emission “benefits” will be more than offset by the increase in the number of aircraft and flights needed to accommodate an estimated 75 percent increase in air passengers and more than a doubling of air cargo tonnage by 2020.

Military aircraft also represent a significant source of emissions, although trends show that these emissions are expected to remain relatively constant into the foreseeable future.

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ARB does not currently have detailed emission inventory data by source type at individual airports. Data from airport master plans and expansion project environmental documents indicate that on-airport stationary and area source emissions are typically one to three percent of total on-airport emissions, excluding aircraft maintenance emissions. If aircraft maintenance operations are conducted at an airport, then stationary and area source emissions can be up to five to six percent of total on-airport emissions.

One of the future mechanisms to reduce the growth in aircraft emissions is to establish alternative travel options that use cleaner technology. The planned California high-speed train system offers the potential to significantly reduce emissions across the State, including San Francisco, Sacramento, San Joaquin Valley, South Coast, and San Diego. A high-speed train system would provide air passengers with an alternative to interstate or local air flights in California as well as connecting links to major airports and rail systems.

The California High-Speed Rail Authority, a nine-member appointed board, is the State entity responsible for planning, constructing, and operating a 700 mile high-speed train system serving all of the State's metropolitan areas by 2020. Recently, the Legislature eliminated the Authority's December 31, 2003 sunset date; included in the 2002-2003 State budget is \$7 million dollars in funding for the first step of the system – completion of a program-level State and federal environmental review. The final environmental document will be completed by December 2003.

Governor Davis signed legislation on September 19, 2002 that places a \$10 billion general obligation bond measure on the November 2004 ballot. This bond would fund the planning and construction of the first phase of the system—connecting Los Angeles with the Bay Area. The second phase of the program, taking about four years, will include a project-specific environmental analysis and preliminary engineering design that would be completed around the end of 2007. Final design and construction of the starter system could be completed within seven years, with the entire system completed within about ten years.

When fully operational in 2020, the system could have an estimated 32 million passengers annually for the base case and up to 55 million annual passengers if air and automobile travel growth rates, air and automobile travel times, and air fares increase. About 45 percent of high-speed train passengers could be diverted from air transportation; thus, substantial emission reductions could occur in the South Coast, as well as Bay Area, San Diego, and Sacramento airports. Approximately half of these benefits could occur in the South Coast Air Basin, since it will be the origin or destination of the majority of trips diverted from air transportation.

### **3. Existing Control Program**

The ICAO, U.S. EPA, ARB, and local air districts have programs to control emissions from airport-related sources.

#### **a. Aircraft Engines**

ARB is pre-empted from adopting jet aircraft engine emission standards, that right being reserved under federal law to U.S. EPA. In practice, U.S. EPA works its standard-setting process through ICAO because aircraft engines are international commodities and jet aircraft frequently operate internationally. ICAO was created in 1944 by the Convention on International Civil Aviation (the "Chicago Convention"). ICAO's responsibilities include developing aircraft technical and operating standards, recommending practices, and generally fostering the growth of international civil aviation. Over 180 nations participate in the organization, including the United States. ICAO develops aircraft engine standards through its Committee on Aviation Environmental Protection (CAEP).

Since 1998, U.S. EPA and FAA have jointly sponsored a national stakeholder group whose goal is to define emission reduction targets for air carriers that include a longer term (post-2010) goal for reductions in jet aircraft emissions. One objective of this process is for ICAO to develop more stringent aircraft emission standards.

U.S. EPA historically has not required military aircraft engines to meet its aircraft emission standards, although the Clean Air Act does not prohibit U.S. EPA from doing so. In areas that have military aviation facilities, emissions from military aircraft can be significant and pose opportunities for reductions if they would be required to comply with U.S. EPA aircraft emission standards.

Current jet aircraft engine standards are listed in Table II-G-2. The net effect of the form of the NO<sub>x</sub> standard is to allow larger engines with higher pressure ratios to emit more NO<sub>x</sub> per unit of rated thrust. In addition to the complex form of the NO<sub>x</sub> standard, aircraft engine emission standards differ from motor vehicle emission standards in that aircraft standards sometimes apply only to newly designed engines, not to all engines manufactured after a specified year.

**Table II-G-2**  
**Current U.S. EPA Emission Standards for**  
**Jet Aircraft Engines**  
**(grams per kilonewton of thrust\*)**

| Pollutant | Standard                         |
|-----------|----------------------------------|
| CO        | 118                              |
| HC        | 19.6                             |
| NOx       | 32 + 1.6 x engine pressure ratio |

\*Thrust is rated output or maximum thrust required for takeoff

ICAO has recently approved a new standard that will apply starting in 2004 and is being proposed for promulgation by U.S. EPA. Again, the standard is written to allow higher-pressure ratio engines to have higher NOx emissions. The new standard will require NOx to be reduced by 16 percent for the smaller, lower pressure ratio engines. However, for the larger, higher-pressure ratio engines, the new standard requires less reductions as the engines get larger with no reductions for the largest ones. Because most new aircraft engines are being designed with higher-pressure ratios, the net effect of the new standard would be minimal change in per aircraft-related NOx emissions. The U.S. and a number of European countries have expressed strongly the need for aircraft NOx emissions reductions, which has prompted ICAO to begin work on a new, more stringent NOx standard.

**b. Ground Service Equipment**

Both U.S. EPA and ARB's on-road and off-road motor vehicle emission standards apply to GSE used in airport operations. Additional information on these standards can be found in the chapters dealing with off-road compression-ignition engines and off-road large spark-ignition engines.

A joint effort by U.S. EPA and ARB resulted in lower emission standards for new off-road equipment, however, additional measures are needed to reduce GSE-related emissions from existing units. Air carriers have historically elected to rebuild GSE engines rather than to replace the units with new, lower emitting equipment. The greatest emission reduction would come from accelerated fleet turnover.

In addition, an enforceable agreement has been negotiated with air carriers to replace older GSE with lower or zero emitting units. The agreement, referred to as the GSE Memorandum of Understanding (MOU), is a joint effort among ARB, U.S. EPA, South Coast District, and the 17 Air Transport Association-member airlines that operate at the five commercial airports in the South Coast Air Basin. The MOU will require the air carriers to reduce their 1997 GSE fleet-average (ROG+NOx) emissions by

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approximately 80 percent by 2010. The MOU does not specify how the airlines are to achieve these reductions, however, the calculation of the 80 percent reduction was predicated on the accelerated turnover and replacement of between 30 to 40 percent of existing equipment with ZEVs. Another 40 percent of the GSE fleet would need to be repowered, retrofitted, or replaced with new equipment that meet lower emission standards.

The MOU also requires air carriers to reduce diesel particulate emissions by installing filters or oxidation catalysts on phase-in schedules that depend on the type and age of the equipment. The MOU requires the use of 15 ppm sulfur diesel fuel after December 31, 2003.

The MOU deals separately with the "growth fleet" (units added to the fleet after 1997 to accommodate growth). Forty-five percent of growth units must be ZEVs, excluding four categories of GSE. The MOU also requires that all non-ZEV units added to the GSE growth fleet must have certified engines that comply with emission standards in place on the date the equipment begins service at the five airports. The requirement will ensure that older, higher-emitting units are not transferred from outside the region.

The requirements in the GSE MOU apply only to those GSE owned and operated by the 17 air carriers that are member of the Air Transport Association that operate at airports in the South Coast Air Basin. International air carriers and regional air carriers that contract with private GSE companies to provide required services at airports are not covered by the GSE MOU. These contractors own and operate approximately 17 percent of all the GSE. Los Angeles World Airports (LAWA) staff has recently begun to renegotiate access leases with businesses operating at the airport. LAWA staff intends to condition the leases to require all entities owning and operating GSE to meet the requirements in the GSE MOU. There may be opportunities for further reductions from GSE at other airports in the region if these airports are able to utilize access leases or similar means for extending the requirements in the GSE MOU to all GSE operating in the South Coast Air Basin.

Major elements of the MOU are described in more detail below. Table II-G-3 presents expected emission benefits of the MOU.

***Reduction in ROG + NOx Fleet Average Emissions:*** The first element requires the carriers to reduce the fleet average emissions of ROG + NOx from their 1997 GSE fleet to 2.65 grams/brake-horsepower/hour between 1997 baseline levels and 2010. This represents an 80 percent reduction. It is based on a high penetration of existing ZEV technologies into the existing GSE fleet as well as the accelerated purchase of new fossil-fueled engines that meet ARB and U.S EPA's most stringent standards for off-road equipment.

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**Zero Emission GSE Vehicles:** The second element requires that a minimum of 30 percent of the 1997 fleet GSE be ZEVs in 2010. Because ZEV technology is already a commercial success for baggage tractors and belt loaders, the MOU anticipates that a very high percentage (85-90 percent) of these GSE will be ZEV in 2010. Other GSE categories, such as aircraft pushback tractors, are less advanced, have some ZEV models, and show promise for commercial development of improved electric battery-powered drives. The MOU also requires that 45 percent of the GSE added to fleet for growth purposes be ZEV, with the exception of four categories of GSE that are not amenable to electrification.

**Electric Infrastructure:** To support the MOU requirement that the air carriers have ZEV GSE by 2010, the airports will need to ensure there is adequate infrastructure for electric GSE where such infrastructure does not exist. Gate electrification to support GSE recharging and that provides electricity and preconditioned air for parked aircraft is becoming more common with new gates and terminals. However, full-scale gate electrification is needed to ensure zero-emitting GSE can be used, and to preclude the need for using the aircraft's turbine auxiliary power unit.

**Table II-G-3**  
**Emission Benefits of Ground Service Equipment MOU**  
**Estimated Emission Reductions in 2010**  
**(South Coast, Summer Planning, tpd)**

| Pollutant | Reduction |
|-----------|-----------|
| ROG       | 0.3       |
| NOx       | 1.5       |

**c. Ground Access Vehicles**

ARB's motor vehicle emission program will cut ROG plus NOx emission rates per vehicle mile by about 85 percent over the next twenty years. Growth in air travel, however, could lead to increases in motor vehicle emissions through the increase in the number of airport-related trips, unless there is a shift to higher occupancy vehicles, e.g., taxicabs, passenger shuttle buses, and local transit.

Trip reduction strategies are primarily the domain of local jurisdictions. ARB has been able to require modest ground access-related emission reduction measures through the air quality certification process. This process conditions federal funding of certain airport projects (new airports, new runways, or major runway extensions) on ARB's certification that the project will not interfere with the attainment or maintenance of air quality standards. Under this process, an airport applying for certification must commit to implement all feasible measures to reduce emissions, including emissions

from ground access and GSE. An example of ARB certification conditions is requiring an airport to purchase or lease low-emission on-airport shuttle buses that meet or exceed the ARB's emission standards for new buses.

**4. Proposed Strategies**

ARB staff is proposing an emission reduction measure for jet aircraft. The implementation schedule for this measure is listed in Table II-G-4.

**Table II-G-4  
Proposed Strategies for Aircraft/Airports**

| Strategies   | Timeframe   |                |
|--|-------------|----------------|
|  | Action      | Implementation |
| AIRPORT-1: Pursue Approaches to Reduce Emissions from Jet Aircraft | 2004 – 2009 | 2008 – 2015    |

**a. AIRPORT-1: Pursue Approaches to Reduce Emissions from Jet Aircraft – More Stringent Engine Standards, Retrofit Controls, Cleaner Fuel, Apply Standards to Non-Tactical Military Aircraft**

**Time Frame:** Adopt 2004-2009; Implement 2008-2015

**Responsible Agency:** U.S. EPA

**Proposed Strategy:**

The proposed approaches for U.S. EPA to cut emissions from new and existing jet aircraft would provide some benefit by 2010, growing over time to help mitigate the net increase in aircraft emissions. Some measures require new technology, new standards, and considerable investments in research and development funding by NASA, airframe manufacturers, and jet aircraft engine manufacturers. U.S. EPA has the responsibility to implement these measures.

**Lower-Emission Aircraft Engines:** This measure calls for more stringent aircraft emission standards and the development of lower-emission aircraft engines. U.S. EPA could work with FAA and ICAO to adopt lower emission standards for: VOC, to reduce both ozone and toxic compounds; PM, to reduce fine particles and potentially toxic compounds; and NOx. The NOx emission standards should reflect at least a 50 percent reduction in per-engine NOx emissions from current standards (known as “CAEP/2 standards”) for all engines for which the date of manufacture of the first individual production model is after 2007. In addition, a longer-range standard of a 70 percent reduction in per-engine NOx emissions from current standards should be adopted for implementation in the 2010-2015 timeframe. These measures depend on substantial funding commitments by both governmental and industry partners to develop integrated component technology demonstrations leading to clean engine certification by 2007 to 2010.

**Install Engine Emission Retrofit Kits:** This measure calls for the purchase and installation of jet engine NOx emission retrofit kits where available and feasible. For example, a retrofit kit developed for Rolls Royce engines that power Boeing 757 aircraft reduces NOx emissions by about 30 percent over existing engines.

**Reformulate Jet Fuel:** U.S.EPA, with concurrence of FAA, has the authority to require the reformulation of jet fuel to lower the sulfur content. Sulfur contributes to PM emissions. Reformulation of diesel fuel and gasoline have resulted in significant emission reductions for on- and off-road motor vehicles. Because of potential benefits for reduced PM emissions, reformulating jet fuel should be evaluated.

***Apply Commercial Aircraft Engine Standards to Non-Tactical Military***

**Aircraft:** U.S. EPA could exercise its authority under the Clean Air Act to require non-tactical military aircraft to meet the same emission standards as the commercial aircraft engines. This measure could result in significant reductions, but cannot be quantified at this time.

**Table II-G-5**  
**AIRPORT-1: Pursue Approaches to Reduce Emissions from**  
**Jet Aircraft**  
**Estimated Emission Reductions in 2010**  
**(South Coast, Summer Planning, tpd)**

| <b>Pollutant</b> | <b>Reduction</b> |
|------------------|------------------|
| <b>ROG</b>       | <b>0 - 0.5</b>   |
| <b>NOx</b>       | <b>0 - 1.8</b>   |

**SIP Commitment for Measure AIRPORT-1**

ARB expects that U.S. EPA would adopt this measure between 2004 and 2009 to achieve 0 to 0.5 tpd ROG reductions and 0 to 1.8 tpd of NOx reductions in the South Coast Air Basin in 2010.